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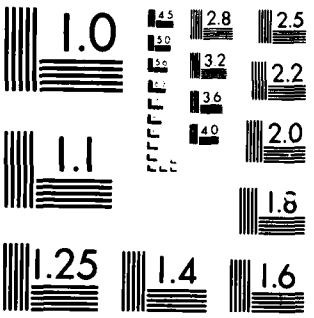

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Science Applications International Corporation

INTERIM REPORT FOR
CONTRACT N00014-84-C-0180,
SUBTASK 28.1

SAIC-85/1597

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Report SAIC-85/1597

INTERIM REPORT FOR CONTRACT N00014-84-C-0180, SUBTASK 28.1

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This report summarizes and references work performed to date in the areas of Arctic environmental modeling and acoustic propagation modeling in the Arctic, under contract N00014-84-C-0180.

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TABLE OF CONTENTS

Paragraph		Page
1.	INTRODUCTION	1
1.1	Contract Information	1
1.2	Background	1
2.	CONTRACT SUBTASK 28.1 - ENVIRONMENTAL CHARACTERIZATIONS	1
2.1	Task Statement	1
2.2	Task Breakdown	2
2.2.1	Requirement 1	2
2.2.2	Work Performed	2
2.2.3	Requirement 2	2
2.2.4	Work Performed	2
2.2.5	Requirement 3	2
2.2.6	Work Performed	2
2.2.7	Requirement 4	3
2.2.8	Work Performed	3
2.2.9	Additional Requirements	3

INTERIM REPORT FOR CONTRACT N00014-84-C-0180, SUBTASK 28.1

1. INTRODUCTION

1.1 Contract Information. This document is an interim report for Office of Naval Research Contract Number N00014-84-C-0180, Subtask 28.1. The work on this contract was conducted during the period from 1 March 1984 to 1 February 1985.

1.2 Background. This task was the first part of a proposed three-part effort to:

1) develop an environmental modeling and data base capability in the Arctic,

2) develop acoustic scattering kernels for ridged sea ice,

3) use the models to support measurement and exercise planning.

Only the first subtask was funded at a partial level. However significant accomplishments were achieved in all three areas, by restricting efforts to problems related to the sea-ice cover. Several technical reports were generated. These and other technical products produced under the contract are summarized and referenced in the next section.

2. CONTRACT SUBTASK 28.1 - ENVIRONMENTAL CHARACTERIZATION

2.1 Task Statement. The Contractor shall develop qualitative boundaries of ice regimes in selected regions. This shall be based on local conditions in first year ice and an estimated time history in multi-year ice. Ice roughness shall be estimated for use in acoustic propagation and coherence modeling. The Contractor shall suggest signal processing and deployment techniques for measuring under-ice roughness with existing systems. The Contractor shall evaluate the need for prediction capability for ice properties and trade-off between real-time measurement and modeling.

The Contractor shall estimate, for areas of interest:

(1) Sediment type
(2) Sediment thickness
(3) Basement type
(4) Basement roughness

The Contractor shall suggest deployment and processing techniques for measuring bottom roughness with existing systems.

2.2 Task Breakdown. The task statement for Subtask 28.1 contains several requirements. The specific work performed and references are given in the following requirements:

2.2.1 Requirement 1. The Contractor shall develop qualitative boundaries of ice regimes in selected regions. This shall be based on local conditions in first year ice and an estimated time history in multiyear ice.

2.2.2 Work Performed. The standard deviation of ice roughness, σ, is the most completely measured and documented description of ice properties related to acoustics. A contour map of this quantity was produced by LeSchack. The first option considered was to intersect the σ contours with contours of other quantities relevant to acoustics, such as keel depth or keel spacing, to develop areas with homogeneous ice properties. Instead, it became apparent that the standard deviation of roughness alone could be used to characterize ice properties for acoustic purposes. Techniques were developed to estimate other keel properties from σ, based on probabilistic techniques. This is documented in SAIC Report No. SAI-84/1132, "Ice Statistics and Acoustic Scattering in the Arctic Basin."

2.2.3 Requirement 2. Ice roughness shall be estimated for use in acoustic propagation and coherence modeling.

2.2.4 Work Performed. A technique for estimating ice roughness spectra from standard deviation ice roughness was developed. These spectra are the inputs required for some TL models and most backscatter and coherence models. This work is documented in SAIC Report No. SAI-84/1132, "Ice Statistics and Acoustic Scattering in the Arctic Basin."

2.2.5 Requirement 3. The Contractor shall suggest signal processing and deployment techniques for measuring under-ice roughness with existing systems.

2.2.6 Work Performed. Two simple techniques were identified for measuring ice roughness, direct vertical profiling and backscatter methods. The two techniques produce quite different results due to an inadequate understanding of backscatter from sea-ice. An improved backscatter theory was developed which brings the methods into agreement. It was shown that the angle of repose of ridge keels is required, in addition to a roughness spectrum, in order to predict acoustic phenomena like backscatter. This work is documented in SAIC Report No. SAIC-84/1805, "A Model of Acoustic Backscatter from Arctic Sea Ice.

2.2.7 Requirement 4. The Contractor shall evaluate the need for prediction capability for ice properties and the trade-off between real-time measurement and modeling.

2.2.8 Work Performed. A model of ice scattering loss from Arctic sea ice was developed for presentation to the Under-Ice-Scattering Model Working Group chaired by Anthony Eller. It was found that archival data on the standard deviation of ice roughness together with the techniques developed in Requirements 1) and 2) above were sufficient to calculate environmental inputs for several ice scattering models. A framework for doing this is described in SAIC Reports, No. SAI-84/1100, "SAI Interim Scattering Model/Ice (SISM/ICE)," and SAI-84/1132, "Ice Statistics and Acoustic Scattering in the Arctic Basin."

2.2.9 Additional Requirements. Additional requirements relating to database issues of ocean bottom sediments in the Arctic were not carried out due to lack of funds.

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